DIGITAL COMPUTER NEWSLETTER

OFFICE OF NAVAL RESEARCH · MATHEMATICAL SCIENCES DIVISION

Vol. 19, No. 1 January 1967

Gordon D. Goldstein, Editor
Margo S. Chernauskas, Associate Editor
Laura A. Repass, Editorial Assistant
Barbara J. Walker, Editorial Assistant

CONTENTS

Approved by
The Under Secretary of the Navy
25 September 1961

NAVSO P-645

Editorial Policy Notices

EDITORIAL

The Digital Computer Newsletter, although a Department of the Navy publication, is not restricted to the publication of Navy-originated material. The Office of Naval Research welcome contributions to the Newsletter from any source. The Newsletter is subjected to certain limitations in size which prevent publishing all the material received. However, items which are not printed are kept on file and are made available to interested personnel within the Government.

DCN is published quarterly (January, April, July, and October). Material for specific issues must be received by the editor at least three months in advance.

It is to be noted that the publication of information pertaining to commercial products does not, in any way, imply Navy approval of those products, nor does it mean that Navy vouches for the accuracy of the statements made by the various contributors. The information contained herein is to be considered only as being representative of the state-of-the-art and not as the sole product or technique available.

CONTRIBUTIONS

The Office of Naval Research welcomes contributions to the Newsletter from any source. Your contributions will provide assistance in improving the contents of the publication, thereby making it an even better medium for the exchange of information between government laboratories, academic institutions, and industry. It is hoped that the readers will participate to an even greater extent than in the past in transmitting technical material and suggestions to the editor for future issues. Material for specific issues must be received by the editor at least three months in advance. It is often impossible for the editor, because of limited time and personnel, to acknowledge individually all material received.

CIRCULATION

The Newsletter is distributed without charge, to interested military and government agencies, to contractors for the Federal Government, and to contributors of material for publication.

For many years, in addition to the ONR initial distribution, the Newsletter was reprinted by the Association for Computing Machinery as a supplement to their Journal and, more recently, as a supplement to their Communications. The Association decided that their Communications could better serve its members by concentrating on ACM editorial material. Accordingly, effective with the combined January-April 1961 issue, the Newsletter became available only by direct distribution from the Office of Naval Research.

Requests to receive the Newsletter regularly should be submitted to the editor. Contractors of the Federal Government should reference applicable contracts in their requests.

All communications pertaining to the Newsletter should be addressed to:

GORDON D. GOLDSTEIN, Editor
Digital Computer Newsletter
Informations Systems Branch
Office of Naval Research
Washington, D. C. 20360

Computers and Data Processors, North America

A Fourth-Generation, Hybrid, Self-Organizing, Bionic, Implicitly and Heuristically Programmed, Pattern-Recognizing, Learning, Neural-Dynamic, Cybernetic, Goal-Seeking, Problem-Solving, Self-Replicating, Evolutionary, Cluster-Seeking, Piece-Wise Linear, Hyperquadric, Self-Teaching, Time-Shared, On-Line, Real Time, Conversational Mode, Interactive, Sketch-Pad, Nanosecond Speed, Non-Parametric, Feature Extracting, Optimal, Stochastic, Artifically Intelligent, Recursive, List-Processing, Interruptible, Robotological, Computing Automaton and Symbol Manipulator That Works on a Syntax-Directed, Cybercultural, Systems Approach With a Mass, Large Scale, Integrated-Microcircuit, Cyrogenic, Thin Film, Associative, Content-Addressable, Modular, Hierarchical, Virtual Memory Capable of Graphic Communication Among Any Number and Variety of Man-Machine Interfaces.

Louis Fein (Consultant)
Palo Alto, California

INTRODUCTION AND SUMMARY

The content-free paragraph given above serves two purposes simultaneously; it is at once both the title of this paper and the paper itself. Multiplexed!*

*Partially, ambivalently, and argumentatively supported by the disESTABLISHMENT--the elite government members of the Artificial Intelligentsia.

Computing Centers

Data Processing Bureau Computer

City of Norfolk
Norfolk, Virginia

In June 1966, the city of Norfolk took a major step toward improving the efficiency of governmental operations with the installation of a new computer—an IBM System/360 Model 30.

The computer will handle the data processing functions of a number of city departments, including management of Norfolk's tax rolls.

"The System/360 Model will enable us to handle all our present functions faster and more economically, yet still have the reserve computer power to handle many new applications as they develop," said Data Processing Bureau Superintendent, J. W. Nixon.

The major jobs to be handled by the computer will include:

- Billings for Norfolk's 90,000 Water Department accounts, including a speedy check of unpaid bills.
- Helping police track down unpaid parking tickets with a higher degree of control than was possible before.
- Welfare Department reports.
- Land usage surveys for city planners.
- Accounting of real estate, personal property, and sales taxes.
- Preparing the payroll for Norfolk's 4,000 city employees, including Federal and State withholdings, Social Security, insurance, and other deductions.

The Model 30, which is located in the Data Processing Center in City Hall, is equipped with four tape drives and three disk files for information retrieval.

"The installation of this computer is another example of the continuing progress being made by the Norfolk city government," Mr. Nixon said. "Its efficient use by more of the city's departments will help save taxpayers' dollars, and enable employees to devote even more of their time to serving the city and its citizens."

Geophysics Division Computer

Headquarters, Pacific Missile Range
Point Mugu, California 93041

A CDC-3100 computer was installed during the summer of 1966 at the Pacific Missile Range. Rented as a replacement for the CDC-160, the new computer is serving the Geophysics Division of the Range Operations Department in specialized geophysical applications. These include reduction of rawinsonde and rocketsonde data and the computation of ballistic wind for application in general impact prediction.

The configuration includes a card reader, paper tape reader and punch, printer, and four magnetic tape units.

Computer Center Growth

University of Pennsylvania
Philadelphia, Pennsylvania 19104

The University of Pennsylvania Computer Center now has two IBM-7040 tape-disk computing systems, two IBM 1401 tape systems, and a PDP-8 computer interfaced with one of the 7040's, set up to service a variable number of remote consoles. These consoles include two Bunker-Ramo 200 series Cathode Ray Displays, and multiple teletype units. Early in 1967, a

DEC-338 Graphic display will be delivered. At present, four remote users can use the equipment simultaneously.

The expansion to larger quarters in the University City Science Center has facilitated usage of the computer center by many research organizations now establishing quarters there. It has also relieved the space problem in the older center.

Delivery of a large, time-sharing computing system (IBM 360, Mod. 67) is expected in July 1967. As software becomes available and demand for service grows, it is planned to upgrade the single-processor system to a multiprocessor system.

360 Computer Expansion

Rensselaer Polytechnic Institute
Troy, New York 12181

As part of an expansion of its $1.5 million computing laboratory, in September 1966, Rensselaer Polytechnic Institute added to its new IBM System/360 Model 50 computer a large core memory storage.

It is the first such unit to be installed in any college or university in America, reports IBM.

The large core storage, designated LCS by its manufacturer, not only makes available faster retrieval of information, but increases the core memory capacity of Rensselaer's computing laboratory by eight times.

Essentially, the new component will be used by Rensselaer for scientific computations in various research activities. Dean Bouton, manager of the computing laboratory, elaborates:

"In the future we will use LCS to speed up our research work, to expand the capabilities of the computer, and to help us develop new computer techniques.

"Our computing laboratory is pointed down the academic path," says Mr. Bouton. "Since the System/360 was put into operation in February 1966, student use has increased and during the summer reached a level of about 1,000 programs a day. Rensselaer's students are using it about 75 percent of the time, both for class assignments and for learning about its operation and capabilities."

In addition to student use, the computer is being programmed for administrative record keeping in such areas as grade reporting, library inventory, and personnel by the admissions office, business office, and the registrar's office, among others.

"The LCS is one step in the expansion of the computing laboratory," says Mr. Bouton. "By June, our staff of operators and programmers will be more than doubled--from the seven we have now to 15.

The new component has a memory storage capacity of 1,048,576 characters. In the 360 computer language, four characters comprise one word, a word being a fixed unit of information. From the LCS, four characters (or one word) can be retrieved in eight millionths of a second.

USDA Washington Data Processing Center

U.S. Department of Agriculture
Washington, D.C.

The Department of Agriculture's new Washington Data Processing Center is one of the most advanced non-defense computer complexes in the Federal Government.

Agriculture Secretary Orville L. Freeman, in authorizing creation of the center on July 31, 1962, brought together two organizations--the Data Processing Branch of the Statistical Reporting Service (SRS) and the Data Processing Division of the Agricultural Research Service. Both were put under the direction of SRS.

The Washington Data Processing Center, officially dedicated in the spring of 1966, is a service function. As such, it makes its services available to all USDA and other Government agencies for specific ADP projects. The center is performing ADP work for 17 USDA agencies and 8 other agencies. The center is located in the sub-basement of the Agriculture Department's South Building.

The center has assembled a skilled staff of systems analysts and programmers and has

instituted a program of 1-year internships designed to train employees for expanding management and technical data processing responsibilities within the Department.

The center has two new computers which provide unprecedented power, as well as flexibility for growth and change: a Model 40 and a Model 30 IBM System/360 computer.

The Model 40 is designed to function as the center's high-speed main processor, the Model 30 is to facilitate conversion of existing USDA data processing resources to System/360 and to work on peakload projects.

The Model 40 has a storage capacity of 256,000 characters of information, with two characters available in 2.5 microseconds (millionths of a second). It can perform 133,300 additions in one second. To get information into and out of the Model 40, the system includes eight high-speed magnetic tape drives, two disk files, a high-speed card reader punch and a high-speed printer.

The Model 30 has a storage capacity of 32,000 characters of information, with two characters available in 3 microseconds. Peripheral equipment includes five high-speed magnetic tape drives, a disk file, a high-speed card reader punch, a high-speed printer, a paper tape reader, and a journal tape reader. An important feature of the USDA Model 30 is programing compatibility with the IBM 1401, 1440, and 1460.

These two data processing systems give USDA the ability to consolidate data processing functions previously performed at several locations. They also are providing USDA and other agencies with additional, more timely, and more accurate information.

The center's present systems have great potential for expansion in such areas as (1) remote terminals, to place the power of a centralized computer at the fingertips of scientific and technical users in various locations; (2) rapid query response (or "turn-around time"); (3) the ability to serve as a centralized data bank for the entire Agriculture Department; and (4) the addition of graphics and graphic displays in such applications as engineering design in Forest Service roadbuilding and Soil Conservation flood-control projects.

Commerce Computer Center

U.S. Department of Commerce
Washington, D.C.

In June 1966 the Department of Commerce opened the Computer Center for Domestic and International Business (DIB). The new equipment will retrieve data for businessmen and for DIB at speeds hitherto unattainable. The use of automated techniques to meet the increased needs of government, industry, and others for timely commercial information is a natural step in the Department's continuing efforts to assist United States businessmen.

A master magnetic tape file has already been established on nearly 450,000 United States business establishments providing information on sales volume, type of business, products manufactured, and other pertinent data.

A complementary file has been made up of all firms currently engaged in foreign commerce, plus those who have expressed a desire to sell overseas. The file, called the American International Traders Index, already represents more than $20 billion in annual foreign sales. This file contains data on products, country, foreign trade representative, and other specialized commerical information.

A Foreign Traders Identification file, similar to the American Traders Identification, is also being established. This will identify manufacturers, agents, and distributors overseas, provide leads on business opportunities abroad, and supply data on export markets by country, company, and product.

Other uses to which the computer will be put cover a wide range of Domestic & International Business activities including the construction of profiles of specific industries in individual foreign countries; reporting the names, addresses, and sizes of the importers and/or distributors of a given product in another country; and analysis of day-to-day export data to maintain a current assessment of present and probable foreign demand for critical materials.

Graphic Picture Language Research

University of California, Los Angeles
Los Angeles, California 90024

Researchers at the University of California at Los Angeles, are engaged in a 3-year project, jointly sponsored by UCLA and IBM, to develop a better method of man-computer communication—namely that of "picture language." This research is being carried on in UCLA's Health Sciences Computing Facility. Dr. Wilfred J. Dixon, the director of the computing facility, stated that "a picture may be worth more than a thousand words in the complex process of computer programming." The project is aimed at simplifying this intricate process for the scientists, engineers, physicians, and designers who use computers.

Scientists at UCLA along with IBM computer specialists are optimistic that they can use "picture language" to develop the programs to simplify the man-machine relationship in solving problems in medicine, biology, and the physical sciences. This would mean a tremendous increase in the flexibility of the computer as a tool in scientific exploration, Dr. Dixon pointed out.

The study is based on graphic data processing equipment developed by IBM. The equipment—two 2250 display units—utilize cathode ray tubes similar to those in television sets to provide a means of communicating graphically with a computer.

These display consoles are being used in selecting, enlarging, and inspecting graphic material. The researcher, by manipulating particular events and simulating different conditions can observe the results graphically as they are accomplished.

Some of the problems being investigated in the study are:

- Methods of organizing, storing, and retrieving a wide variety of medical information about hospital patients for use by doctors, nurses, and hospital administrators.
- Analysis and interpretation of electroencephalograms and electrocardiograms and other physiological data.
- Development of a scanning technique that would sort and classify microscopic X-rays of chromosomes. This technique can also be expanded to the study of clinical X-rays.
- Mapping of weather, oceanographic and geophysical studies, and experiments in nuclear physics.
- Construction and modification of three-dimensional engineering models to determine their resistance to stress and strain under various conditions.
- Use as an educational tool to show students how cells grow or atoms react.

The graphic data processing system is linked to an IBM System/360 Model 40. This equipment makes it possible to handle not only information recorded in digital form, but also information in the form of sketches, diagrams, drawings, graphs, charts, X-rays, microfilm, and photographs. These are stored on photographic film and converted to digital form for analysis. If storage is again required, the information can be returned to photographic form.

Many complex problems are more easily understood when reduced to a graphic format, Dr. Dixon said, and this system provides a "window into the computer." The instantaneous exchange of information botween man and machine can help cut considerably the time between the origin of an idea and its execution.

A researcher can use the graphics system to try various alternatives in seeking a solution to a problem by actually "seeing" what the outcome will be.

For example, with the graphics system a scientist can:

- display on a cathode-ray screen a drawing or picture stored digitally within the computer;
- change the drawing with an electronic "pen" similar to a pocket flashlight; and
- record the modified image in the computer or make a microfilm copy that can be enlarged and reproduced.

Computers and Centers, Overseas

Series 90 Model 40 Time Sharing Computer

G.E.C. Computers and Automation Ltd.
Wembley, Middlesex, England

A new general purpose multi-console high performance time-sharing computer introduced by G.E.C. Computers and Automation Limited in July 1966 provides a range of programming languages and aids previously available only with more expensive systems.

Known as the Series 90 Model 40, the computer enables up to 32 remotely-located operators at a time to carry out on-line program preparation and debugging. In effect each user has at his sole disposal a processor with a 16,384-word memory store and a memory cycle time of 1.75 microseconds. Words from the memory are selected as random blocks from a core memory pool which can contain as many as 65,536 words.

Said to be particularly suitable for system organisation problems and for instructional duties at universities and colleges of advanced technology, the Model 40's special features include the choice of "monitor" or "user" modes of operation, dynamic program relocation, memory fragmentation, and memory protection to prevent one user from destroying or gaining access to the programs or data of another user.

Unlike other medium-cost time sharing systems, the computer provides a variety of programming languages—FORTRAN II, a scientific language; CAL, a conventional algebraic language; SNOBOL, for string manipulation; QED, a conventional text editor; and LISP, a symbol-manipulating language using recursive list-processing techniques which is especially useful for mathematical applications and logical analysis.

The Model 40 also has a macro-assembler which permits programs to be written in machine language. All the languages are controlled by a time sharing executive program which allows users to select the language that best suits their problem and operating ability.

The computer is supplied with a synchronous high-speed communications system which enables ten characters a second to be transferred between the computer and up to 32 keyboard printers. The communication system's response time ranges from two to three seconds according to the number of users and when up to six operators are using the machine simultaneously the response time is faster than 1 second. Another advantage of the computer is its ability to load programs into any available part of the core memory continuously, so that users do not have to wait for a specific memory allocation.

The computer has a 24-bit word size and for floating point arithmetic this can be increased to 48 bits. Other advantages include built-in "multiply" and "divide" logic circuits, automatic checking of memory transfers and input/output operations, multiple level indirect addressing with indexing at any level, and up to 1,024 levels of priority interrupt, each with a unique priority and address in memory.

Input/output rates of up to 572,000 words a second can be attained and numerous peripheral units can be used, including random access disc files, display scopes, character and vector generators, magnetic tape transports, line printers, card readers and punches, paper tape equipment, and digital plotters.

The Model 40 system is compatible with all other types of Series 90 computers and was developed by G.E.C.'s associates, Scientific Data Systems, of Santa Monica, California, and the University of California.

INAC Computer

Instituto Nazionale Per Le Applicazioni Del Calcolo
Rome, Italy

The Instituto Nazionale per le Applicazioni del Calcolo (I.N.A.C.) of the Italian National Research Council (C.N.R.), in Rome, has acquired a new computer—the INAC Computer. Acceptance tests were successfully completed in February 1966. The com-

puter, called CINAC for short, is the result of a 4-year joint effort by the Italian National Research Council and the Electronic Division of the Olivetti company (later Olivetti General Electric).

The system consists of: a central processing unit; a main memory unit; and up to 8 synchronizers, each capable of dealing with up to 16 peripheral control units, each controlling communications with a peripheral unit, with external lines, or with another computer. The main memory can have up to 65,536 directly addressable words (24 or 48 bits each) and is automatically time-shared by the central processing unit and the synchronizers.

ADDRESSING

A memory location can consist either of any number of characters of 3, 6, 8, 12 bits or of one word of 24 or 48 bits. A memory location is addressed through a "description," which gives the address of its most significant character and the number of its characters. In general the number of bits per character is implicitly dictated by the type of operation to be performed but I/O instructions and a few others can specify the number of bits for the characters to which the particular instruction refers.

Descriptions associated with each program segment are grouped in a "reference list," the initial address of which is contained in a special register, so that the re-allocation of the reference list can be done by changing the content of this register.

The reference list can contain not only descriptions but also operands (in general, program constants).

CENTRAL PROCESSING UNIT

This unit includes the arithmetic and central control sections of the computer.

Its most significant feature is a stack, formed by two 48 bit registers (which are the top of the stack) and a "stack point." When the two top of the stack registers are full and new data is brought in, their contents are pushed down in the memory address given by the stack pointer.

An instruction is composed of 12 bits and can be either an "onoma" (the Greek word for name) or an "operator."

An onoma is the relative address of a word in the reference list and when the control unit reads it from the memory the absolute address corresponding to the onoma is put on top of the stack.

An operator is the specification of an operation to be performed by the computer on the top of the stack or on the memory locations therein described.

The result of the operation (if any) is left in the stack. Therefore, apart from the data, a program consists of a reference list (which is a sequence of program constants and of descriptions of memory locations) and of an "operative string."

The latter is a sequence of instructions (i.e., operators and onomata) and, due to the stack mechanism described above, is a Polish string in machine language. In fact, each operation is specified by a sequence of onomata (or operands) followed by an operator, in a way directly derived from the so-called reverse Polish notation.

Unless a programmer specifies, an operative string does not vary when executed or when its memory position (or the memory position of any other constituent of the program) is changed. Actually all changes to be done in case of memory reallocation or of reallocation of the names of the peripherals are concentrated in the reference list.

Since there are special operators for operating on the reference list, if this is properly structured the up-dating necessary in the event of any kind of reallocation is elementary.

Therefore the computer can be easily used in a time-shared, multi-programming system and, on a humbler level, programming tasks in machine language can be easily split between many coders.

The instruction repertoire includes instructions for calling subroutines, which automatically form one stack for memory working areas and another one for reference lists. This facility allows a subroutine to call itself and, what is more, optimizes memory allocation without any programming effort.

Therefore it can be said that, in a way, the machine language of this computer is already at assembly language level.

PERIPHERALS

On the other hand, one could say that the machine language is at micro-programming

level as far as peripherals are concerned. This means that there is only one fundamental type of I/O instruction which can be adapted to any kind of peripheral device through reference to a descriptor, i.e., to a word which further specifies the operation to be performed.

This philosophy is ideally suited to the use of supervisors which are an inseparable part of today's computers.

THE COMPUTER

The initial configuration of the system is the following: 24,576 words of main memory with a cycle-time of 2.7 micro-seconds, 4 tape units at 83,500 characters per second (6 bits), a parallel printer at 600 lines per minute, a paper tape reader and a teleprinter.

A special custom-built console is the reproduction of the console and man-machine interface of a previous computer so that old programs can be used directly through a simulator.

Disk units will be installed in 1967.

Addition time as measured at the acceptance test was 2.3 micro-seconds (excluding operand access).

The various units are coupled asynchronously through a standard interface.

The computer performance has been very satisfying since its acceptance test.

Air Traffic Control System

The Marconi Company Limited
Chelmsford, Essex, England

A massive, computer-controlled flight plan processing system, ordered from The Marconi Company by the Ministry of Aviation at a cost of over £ 1.2 million, will put London ahead of the world in the automation of air traffic control services.

The system is scheduled to be installed in 1969, at the new London Air Traffic Control Centre at West Drayton, near London (Heathrow) Airport. It will replace the present, interim equipment in the London centre, and will form the basis of a plan for the full automation of air traffic control services.

It will be based on a triplicated Marconi Myriad computer system which will handle flight plans and control data for all aircraft under en-route air traffic control in the southern half of the country. The Myriad computers will automatically process the vast quantity of traffic information in a fraction of the time required by present methods. This will simplify the task of the Air Traffic Controller and will provide the additional capacity which is needed to cater for the expansion of air traffic into the 1970's, and the introduction of supersonic aircraft.

This new system will forge ahead of even the advanced system at New York. The triplicated Myriad system will give extreme reliability and greater speed, while the use of 'touch displays' will provide a unique man-machine interface, replacing push-button controls and bringing the Air Traffic Controller into direct, finger-tip contact with the air picture.

The system will be capable of future extension to link with similar control centres throughout Europe and the rest of the world. Advanced plans have already been formulated by the International Civil Aviation Organization for a fully integrated, world-wide, air traffic control system to provide the degree of international automation which will be essential in the supersonic age.

HIGHEST ORDER OF RELIABILITY

Three Marconi Myriad microelectronic computers will be used to provide the speed and reliability which are essential to a complex system of this type. Each of these three computers will form the basis of a separate processing chain, to provide a fully triplicated system in which an interruption in processing, lasting more than thirty seconds, must not occur more than once in five years. In effect, this virtually outlaws failures of any consequence.

The Myriad computer is currently in operation in the British military satellite communications ground stations built by Marconi, and the same computer has been ordered for process control and defence projects in a number of countries.

THE TOUCH DISPLAY SYSTEM

The 'touch' displays, which will be used widely throughout this installation, provide a

completely flexible input system which is fully integrated with an output display in an electronically 'written' form. This system consists of an electronic tabular display, with a matrix of very fine wires embedded in the lower half of the display face plate. The computer writes details of the traffic on the tube in such a way that those items which the controller may wish to modify, or about which he may require more information, coincide with the touch-wires. The controller can then request information from the computer, or modify the flight plans or make decisions, by simply touching the relevant items on the display. The computer will then change the display, either to provide the information called for, or to show the results of a modification, or the effect of a decision. This display must then be confirmed before the new instructions are passed to the system and on to the pilot. This unique man-machine interface is extremely flexible and the computer can be programmed to show sequences of possible instructions, or items of information, in any logical form determined by the control system.

The end of each touch-wire is exposed in the surface of the face plate, while the other end is connected to a sensitive trigger circuit in the display back-up unit. When the operator touches a wire, he upsets the electrical balance of this trigger circuit. The trigger is designed to make a positive input to the computer when the wire is touched firmly. Particular care has been taken to ensure that a hesitant touch cannot cause jitter, and that adjacent touch-wire circuits are not affected.

The function of each touch-wire is determined by the computer programme as necessary, and appropriate labels can be written, from the programme, next to each touch-wire.

In this way, the touch-wires can be made to fit the requirements of the displayed information, and their functions and labels can be made to simplify the task of the operator by dictating his operational procedure in a logical sequence. In a simple case, for example, the display will list all aircraft flying in a given sector of the airspace. The touch-wires will enable the controller to select more detailed information on any one of these aircraft. Seconds later, these same touch-wires might be used to call up a display of reporting points, and the times at which this and other aircraft will pass them.

The principle of this unique display/control system was originally established by the Royal Radar Establishment, and practical equipment has subsequently been developed under license.

FASTER AND MORE ACCURATE INFORMATION

The actual control of aircraft movements will be carried out by the Air Traffic Control Officers as at present, but they will have much faster and more accurate information on the air situation at any time. Flight plans, supplied by neighbouring control centres or by the pilot, will be processed by the Myriad computer complex, in conjunction with meteorological data and aircraft performance figures. The complete structure of the airways system over the South of England will be contained in the computer, together with the positions of all airways and the reporting points or radio navigational aids, which enable a pilot to fix his position.

The computers will calculate the time at which each aircraft should pass all such points on its course, and present the appropriate ATC Officer with this information for all aircraft in his sector of the airspace. The computer will also be able to look into the future and plot conflicting situations before they arise. As each reporting point is passed, the actual time will be fed into the computer, to bring the expected times of arrival at subsequent reporting points up to date.

RAPID ESTABLISHMENT OF CLEARANCES

The flight plan processing system will be complementary to the radar data processing system at West Drayton, for which Marconi is a major contractor. The two systems will eventually be completely integrated.

The principal aim is to provide the controller with the fastest and most certain means of establishing clearances for flights, although a wide variety of information will be available on the progress of all aircraft, together with calculations and predictions based on this information.

Any air situation can be presented to the controller instantaneously, on touch and other tabular displays in plain writing, the simplest and most effective form. Changes will be incorporated automatically as new information is processed through the computer system.

With the touch displays, the controllers input path to the computer will be directly related to this display of information, enabling him to make the best possible use of the infor-

mation and to take full advantage of the very high speed of the computer system.

A series of operations, through the touch display, will provide a complete clearance for a flight plan in a few seconds. Points at which conflictions would occur in the future will be clearly indicated, and alternative routes can then be established and cleared by the same method.

DISPLAYS IN SEVERAL FORMS

Apart from the extensive use of touch displays, information will be passed to the controllers in a variety of other forms. Strip printers will produce printed "Flight Progress Strips" for each sector controller. These slips of paper will provide the basic information for the existing method of air traffic control. Electronic tabular displays will provide an instantaneously updated display of similar information on a number of aircraft passing over a given route or reporting point. Page printers will produce a continuous summary of all information in the system. This summary will be available to the Planning Controllers and will also provide a permanent record of all aircraft movements, and the control procedures used to handle them.

DATA PROCESSED IN FRACTION OF A SECOND

The Myriad computer is the fastest, on-line, processing machine in the world, and is ideally suited to this type of work. It incorporates an eight-level "priority interrupt" facility which ensures that data are handled in the correct order of urgency. This facility is vital to this system, since the number of separate input points is extremely large, and a considerable volume of data will require attention at any one time. Over 50 input positions and 100 output positions are planned, and the system will contain over 1200 fault indication circuits which will feed into the computer system. Messages carrying the highest priority will be handled instantly, and only a fraction of a second will elapse between the receipt of an incoming message and the appearance of the processed information on the appropriate display screen.

DIRECT LINK WITH AIRPORTS

The system will be linked directly with both Heathrow and Gatwick Airports in the London area. Flight plans filed at either of these airports will be fed directly into the system from "typewriter" keyboard input positions, while touch and tabular displays, and strip printers will be provided in the Control Tower and Flight Clearance Office at each airport.

Automated Swedish Weather

The Marconi Company Limited
Chelmsford, Essex, England

The most advanced meteorological automation system in the world has been ordered from The Marconi Company by the Royal Swedish Air Force Board. This system will be used by the Swedish Military Weather Service and it is estimated that it will be in service by 1969. A number of high speed, Marconi Myriad computers will be used at two forecast centres, to accept and process weather information from ground stations and weather ships throughout the Northern Hemisphere and from weather satellites.

This high degree of automation will make it possible to produce, much more rapidly than by conventional means, a wide range of general and specialized forecasts for the Swedish military forces. It will also ensure that all relevant data is included for a given area. This has not been possible before, because the amount of data to be processed is so large that it cannot be fully processed by manual methods in a reasonable time. The high processing speed of the new system, will also make it possible to produce more frequent short term forecasts.

Some three million teleprinter symbols, which at present make up the daily weather information for the Northern Hemisphere, will be fed directly into the computer complex, where they will be decoded, checked and sorted. This quantity of data is expected to multiply in the near future. Weather maps, from which forecasts are made, will be produced automatically on digital plotters and data will be displayed in written from on electronic tabular displays. In some cases, even the forecasts themselves will be produced automatically by the computer system.

There is no paper involved in the entire forecasting chain, apart from the weather maps plotted by the computer. All other information is handled "on line" by the computer, and presented, as necessary, on electronic tabular displays.

The complete system has been designed to be capable of considerable expansion in the future, should the need arise.

Programming of the Myriad computers will be undertaken by Marconi and Svenska Radio AB in close co-operation with the Swedish Air Force Board and the Military Weather Service.

THE WORLD METEOROLOGICAL SERVICE

Meteorological information is derived today from sources in every country in the Northern Hemisphere, and from ships, aircraft, and satellites covering large parts of the oceans and deserts. This information is brought together and assembled in a standard form, for transmission to meteorological centres throughout the world. Any national centre can therefore receive data from all countries, and obtain a very complete picture of the world weather situation, on which its own forecasts can be based.

This information is passed between the various centres in the form of teleprinter or telex messages, which are coded into a standard short form. At any single centre, the world weather information is received in the form of some three million telex characters per day, sufficient to occupy ten teleprinters, working continuously throughout the day and night.

Part of this incoming information is normally plotted on charts and afterwards analyzed by meteorologists. Other types of observation are drawn as diagrams or tabulated; showing, for example, the vertical structure of the atmosphere. The meteorologist's analysis involves the marking of the various air streams, cloud precipitation and fog areas, fronts, winds, etc. From these maps, expert meteorologists can forecast the weather conditions at any point, for some time into the future.

The plotting of this enormous volume of data is a lengthy process, requiring a large staff of skilled plotters.

THE NEW SWEDISH SYSTEM

This new system will eliminate the lengthy process of plotting this information by hand, and will enable the charts to be updated almost as soon as new information is received.

Teleprinters will be entirely eliminated from the two Swedish centres, and all incoming telex messages will be fed "on line" directly into the Myriad computers. The information will be decoded by the computer, and passed into magnetic disc stores from which it will be immediately accessible for further processing.

The system will have sufficient interpretive power to decipher the majority of minor errors in the received information, and by correlating all new data with earlier received data, it will be able to recognize many more fundamental mistakes. Any message that cannot be deciphered satisfactorily by the computer system, will be displayed to a meteorologist on an electronic tabular display. He will be able to return his interpretation of any garbled information to the computer, using a keyboard input.

These tabular displays will also be used to show the operator any new data which differ from previous data to a major extent, and which the computer considers may be either suspect or vitally important.

WEATHER MAP PLOTTERS

A number of automatic digital plotters will produce the various weather maps from which forecasts are made. These maps will be produced at set times during the day, or on request from the meteorologists. Isobars and isotherms will be plotted automatically, together with the wind structure, calculated by the computer.

The majority of major forecasts will be produced by the meteorological staff from these maps, although height-wind forecasts, and a number of other specialized predictions will be supplied by the computer itself.

GIGANTIC COMPUTATION

This new system will also make it possible to use an important development in forecasting techniques based on the very large volume of data which can be handled in a very short time. This forecast will be based on the use of a new mathematical model of the complete mass of air covering the Northern Hemisphere.

Information on the conditions in the upper airspace at a large number of points is derived from meteorological balloons, and also from weather satellites. The very detailed nature of this information makes it possible to consider this huge mass of air as a single, complex system, and to predict future weather conditions by the simple application of the gas laws over

the whole area. This involves a gigantic computation which would take months without the aid of a computer, but which can be done in less than an hour by the large scientific computers which are now available.

In the Swedish system, this forecast will be undertaken by a very large machine at the Swedish Defence Research Establishment in Stockholm. Economically, it is not possible to incorporate the necessary computing capacity in the meteorological centres themselves, since it would be used for less than an hour in every twelve hours.

SPECIALIZED FORECASTS

The very rapid production of both ground level and upper air forecasts will make it possible for the meteorologists to produce a very wide range of specialized forecasts for the Swedish Armed Forces in a fraction of the time taken by conventional methods. In many cases, where a short term forecast is essential, it will be made possible only by the speed of this new system.

DIRECT INPUT AND OUTPUT OF TELEFAX OR TELEPRINTER SIGNALS

In addition to the pen plotter, which will be used to provide maps and charts directly from the data contained in the computer system, the computer will be capable of producing telefax signals which can be transmitted directly over telephone lines to remote points. These same maps can then be printed out on telefax machines at weather stations all over Sweden. Telefax signals will also be accepted "on line" by the computers from telephone lines or radio.

In the same way, written data in the form of teleprinter symbols can be generated in the computer, and fed directly on to telephone lines.

An additional form of graphical input to the computer is provided by a pencil follower device, which enables hand drawn information to be fed directly into the computer.

Miscellaneous

English For Computers

Bell Telephone Laboratories
New York, New York 10014

A new form of English will eliminate computer confusion about the relation of words in a sentence. The language, which was developed at Bell Telephone Laboratories, is called FASE for "Fundamentally Analyzable Simplified English."

Sentences in FASE can be easily parsed (resolved into parts of speech) by a computer. For this reason, FASE may eventually be the basis for information retrieval by machines in libraries and institutions which handle large numbers of written documents. For readers, FASE is indistinguishable from ordinary English. For example, this story is written entirely in FASE.

FASE was devised by Dr. Lee E. McMahon, who is a psychologist studying ways of improving communications between computers and people. His work at Bell Labs is part of research in communications sciences -- an area which includes the study of future communications networks which will handle messages between computers or between man and computer.

Dr. McMahon has reduced the English language to a strict form in which syntax (the orderly arrangement of a sentence) is clear and sentences are easily broken into component grammatical parts to avoid ambiguity. For example, "Time flies" would be ambiguous to a computer because the roles of the noun and verb are interchangeable. In addition to its popular interpretation, this expression could well be an imperative statement demanding that we clock the little insects.

However, a sentence in FASE strictly maintains the sequence of subject, verb and object; modifiers like adjectives and adverbs, and other parts of speech must fall into line. A complicated set of rules has been devised to ensure unambiguous syntax.

Consider "Time flies" again. A computer which reads FASE would interpret this correctly, since "time" would be taken as a noun. To demand that someone clock the insects, we would have to rewrite the sentence. For example, we might say "Determine the speed of flies."

While syntactic ambiguity has been eliminated in FASE, problems arising from semantic ambiguity still must be overcome. For example, in "John throws a ball every night," it is not clear whether John likes athletics or parties.

Dr. McMahon believes that FASE is an adequate tool for communicating a broad range of ideas and that FASE can say anything which needs saying. Since long passages of FASE may produce a somewhat flat prose, the language is most useful for applications in which clarity of expression is preferable to an elegant style. For this reason, its immediate application would lie in the mechanical indexing of scientific abstracts or documents.

In a FASIC operation, abstracts or documents would be written or rewritten in FASE. They would then be punched on cards, and stored in a computer. The computer might then be instructed at any time to index or to retrieve information by a special program based on FASE grammar. These documents can be indexed and retrieved on the basis of grammatical units and relations which are not useful in present systems because of the syntactic ambiguity of natural English.

Dr. McMahon estimates that a competent writer of English would need a few months to learn how to write FASE fluently. Instead of asking that writers and scientists learn the language, he suggests that specialists might be trained for writing or translating in libraries and centers for computer work, if the system is ever widely adopted.

FASE also may provide a more accurate computer translation of foreign languages. Automatic translation of foreign scientific papers is growing into a big business; but the results are not always reliable. Although present mechanical translation is based on grammar to an extent, it involves complicated series of

computer decision-making. To some degree, these necessary complications compensate for inherent ambiguities in the language being used. FASE, which removes the syntactic ambiguities in English, would simplify the task of the computer and lessen the chance of error.

Portable Suitcase Teletype

Carnegie Institute of Technology
Pittsburgh, Pennsylvania 15213

The world's first portable suitcase computer station designed to keep modern man in instant communication with stored information anywhere in continental North America, has been developed at Carnegie Institute of Technology.

The compact, hand-carried device—called Dataport—was designed and developed by Jesse T. Quatse, engineering development manager at Tech's Computation Center.

Dataport is a computer terminal. It will "plug in" to the largest computer available anywhere in North America, giving its operator full use of that computer.

Dataport can be operated from the operator's home, office, hotel room or—with slight modifications—from his car.

The two-component device consists of a Typing Unit and a Control Unit, each measuring only 14-1/2 inches x 19 inches x 9-1/2 inches. Each component is smaller than the average suitcase. The Typing Unit weighs 37 pounds and the Control Unit weighs 39 pounds.

Dataport operates via an ordinary telephone. The computer terminal is plugged into any regular ac electrical outlet. The telephone receiver is placed into the computer's telephone interface, a component of the Control Unit. Then, by ordinary dialing of the phone, the Dataport operator is put in communication with the computer he seeks to contact.

By use of the typing unit, a teletype device, the Dataport operator programs his problem to the master computer. The answer is returned to the Typing Unit at the rate of 10 characters per second. An automatic device on Dataport permits the operator to leave it unattended and still receive his answer anytime the master computer sends it.

When fully operational, Dataport draws about 400 watts, roughly one-half the wattage used by an average household iron.

Mr. Quatse said the purpose of Dataport is "to provide ubiquitous information," that is total access to any computer in the United States, Canada and parts of Mexico, from any point where there is a telephone. Although Dataport operates over Bell Telephone system lines, there is no extra charge involved. Only regular long distance rates are levied.

There is no computer device similar to Dataport anywhere in the world, Mr. Quatse said. The first 16 machines will be purchased by Carnegie Tech. Eventually, Dataport will be available to schools, industries, and individuals.

According to David H. Nickerson, acting director of Tech's computation center, plans call for the machines to be used by Carnegie Tech personnel delivering lectures in other parts of the country, for faculty members, who will be away from Tech for extended periods, but who want access to the computer, on loan to persons needing information stored in the Tech computation center, and by various faculty and graduate students for intensive research projects.

A potential business use of the unit may be as a third party in a sales conference where the machine will be available to both salesman and customer as a tool for producing—at the touch of a finger—all company, product, and past sales records.

With patents applied for, Dataport is now being produced by a Pittsburgh firm headed by Mr. Quatse. Full production, he said, is expected by this fall.

The man behind the machine said it took him about a year to develop Dataport after he first conceived it.

Mr. Quatse holds two degrees from Carnegie Tech; a bachelor of science degree in physics (1953), and a master of science in electrical engineering (1962). He has completed all requirements for his Ph.D., except thesis. He has been manager of engineering development at Tech's computation center since 1963.

Before coming to Tech, Mr. Quatse was a Pittsburgh public school teacher; Engineering Group Leader, and later engineer, Control Data Corp.; and engineer, Bendix Computer Division.

Editor's Note: Subsequent to this announcement, another organization has developed a single suitcase (approximately 40 pound) unit.

Computer Typesetting Glossary

Composition Information Services
Los Angeles, California 90028

Completely updated and expanded threefold in its content, a second edition of the CIS Glossary of Automated Typesetting and Related Computer Terms has been released by Composition Information Services—a management organization concerned with electronic applications in the printing and publishing industries.

The new 112-page publication is an encyclopedia of automated typesetting progress and practice containing well over 1,000 entries detailing all facets of modern typographics. Particular emphasis has been placed on computerization and the associated use of photographic procedures.

As the stable, traditionally mechanical task of setting type now moves swiftly and pervasively into the computer age, the CIS Glossary has accepted the mission of organizing and explaining the novel jargon accompanying the change.

In addition to descriptions of systems, hardware, and the full range of typesetting machines, Glossary coverage encompasses both basic and more advanced terminology in such related subject areas as tape-controlled typography, photographic composition, data transmission, text editing, optical character recognition, cathode ray tube character generation, and the like. In essence, the Glossary provides a practical reference with which to understand and assess the ensuing marriage of typographic and data processing within the graphic arts field.

Available to CIS subscribers without charge, the Glossary may be purchased by non-members at $15.00 per copy. Glossary orders, or requests for literature concerning CIS membership, should be directed to Composition Information Services, 1605 North Cahuenga Blvd., Los Angeles, California 90028.

Survey of Information Centers

Office of Standard Reference Data
National Bureau of Standards
Washington, D.C. 20234

The Office of Standard Reference Data conducted a survey of approximately 40 information centers to obtain information on operating experience that would be helpful to the planning and design of its Information Services program. Details were requested on the following matters: (1) general method of operation; (2) type of services and charges; (3) handling of inquiries; (4) costs; (5) personnel; (6) facilities; (7) equipment; (8) quality control; (9) statistics on documents processed; (10) indexing and classification procedures; (11) storage and retrieval; and (12) most efficient techniques.

The survey revealed that most of the responding centers are mission-oriented, serving a specific qualified audience, and are usually supported entirely or almost entirely by a government agency. Most products and services are usually available on request and almost always free of charge. Some, however, offer services and products at the cost of a membership fee.

Most information centers operate formal inquiry services available to their specialized audiences without any cost to the inquirer. Some charge if generation of replies will cost beyond a specified amount; some will charge cost of copy reproduction only; most are concerned with costs and have set a limit for the amount of time to allow for generation of replies; some will provide, on a cost reimbursement basis, "special reports" for a specific customer's unique interest and not for general distribution.

Among the types of activities and services performed by information centers are: (1) storage of data, information, and documents; (2) retrieval of data, information, and documents; (3) lending and/or selling of documents; (4) compilation of data, information, bibliographies, directives, and so forth; (5) performing literature searches; (6) evaluating data and/or literature input; (8) preparing thesauri, indexes, abstracts, and extracts; (9) developing state-of-the-art papers and critical reviews; (10) issuing ad hoc and/or serial publications such as newsletters, journals, and so on; (11) engaging in communication and information research; and (12) contracting for products and services.

Among respondents, personnel ranged from two in one center to 18 full-time and 42 part-time employees in another. The key personnel are universally professionals with advanced degrees, often on the doctorate level, and are technical specialists in the central area of the technical mission of the center. Usually each center has such key technical individuals in the information services.

Physical space ranged from 2400 to 40,000 square feet. Specialized missions often require specialized facilities, such as fire proof vaults with humidity controlled film cabinets.

Most centers indicated they use some standard form of mechanized data processing equipment to some extent. Only one center indicated that it uses primarily a manual system for storage and retrieval. Other than the normal office equipment, that most often mentioned included copiers, microfiche readers, viewers and printers, offset presses, and data processing equipments.

Most respondents answered the item on quality control measures with generalized statements on establishing proper standard operating procedures and checking that these are strictly followed. "User feedback" was a phrase often employed, but few details were given on how this mechanism operated, other than through personal contact.

Statistics were provided by respondents on number of documents in their input, the number in their output, the number of inquiries received and serviced. These varied with size and missions of center.

Indexing and classification approaches depend on the technical mission of the center and the consumer served. Both single and conjunctive access indexes are used. Indexes are arranged by subject, by geographical factors of subject matter, or by hierarchical considerations of the special technical content of the center's mission. Thesauri are frequently utilized.

A wide gamut of storage and retrieval approaches were indicated—from the traditional card catalog, manual system to a mechanized weighted term index, stored in a large computer. Accession numbers cross-indexed with corporate sources, as well as key words, play a role in some systems.

Among efficient techniques mentioned were: (1) field of interest register of users; (2) use of reference and cross reference files; (3) gearing entire system to user needs, minimizing irrelevant material user sees; (4) continual personal contact with the user; (5) placing primary emphasis upon selection of personnel used for evaluating data; (6) design study preceding actual system of operation and testing of design procedures through actual operation for checking and improving system and its details; (7) use and maintenance of Operations Manual containing outlines of detailed procedure for all of the operating personnel.

Among comments received, four in the form of questions requiring decisions by a center are worthy of note: (1) Are you to use the same personnel to abstract and index who answer the inquiries? Is this going to be their sole occupation? (2) What type of people do you want for information services and how do you motivate talented people to take an interest in this field? (3) How do you keep specialists up to date if they have a wide variety of fields to cover? (4) What balance do you strike between travel, reading, answering inquiries, and consulting with visitors?

Computer Programming Documentation Standards and Specifications

Naval Command Systems Support Activity
Washington, D.C. 20390

Programming documentation standards and specifications have been developed by the Naval Command Systems Support Activity (NAVCOSSACT), Washington. The new documentation system was developed to insure that complete and uniform documentation supports the development and turnover of all NAVCOSSACT projects which are related to the implementation of computer systems. Although the standards and specifications are oriented towards NAVCOSSACT operations, they could be generally applied by any organization which prepares computer programming documentation.

STANDARDS

The standards, which describe conventions associated with document preparation and flow

charting, include the following:

01 DOCUMENTATION FORMAT—Establishes document format requirements.
02 DOCUMENTATION TYPOGRAPHY—Provides typing instructions for text division, page numbering, tables, and illustrations.
03 DOCUMENTATION PRODUCTION—Presents standards for paper stock, printing, and binding.
04 DOCUMENTATION SECURITY IDENTIFICATION—Summarizes security identification requirements for NAVCOSSACT documents.
05 DOCUMENT NUMBERING—Establishes a document numbering system.
06 DOCUMENT DISTRIBUTION LIST—Lists addresses for final distribution of programming documentation.
07 FLOW CHART SYMBOLS—Establishes standard symbols to represent processing operations on charts. The symbols are those promulgated by the American Standards Association (ASA).
08 FLOW CHART FORMATS AND GUIDELINES—Provides guidelines for formatting flow charts and using the standard symbology.
09 CHART TYPES—Presents a set of chart types to be included and referenced in programming documentation.

SPECIFICATIONS

The specifications outline the content and organization of the ten documents listed below. These documents may be produced to support a project from analysis to turnover.

Operational Performance Specifications

1. Functional Description
2. Data Requirements Document

Internal Design Documentation

3. System/Subsystem Specification
4. Program Specification
5. Data Base Specification

Manuals

6. Command Manual
7. Operations Manual
8. Program Maintenance Manual

Test and Turnover Documentation

9. Acceptance Test and Turnover Plan
10. Acceptance Test Analysis Report

The Functional Description is a technical document which defines performance requirements, preliminary design, and impacts of the new system to the user. It also serves as a management tool by providing a basis for mutual understanding between user and developer concerning the operational capability to be developed.

The Data Requirements Document is prepared when a substantial data collection effort is required by the user. It communicates data requirements to the user which were not available when the Functional Description was written, including data collection formats when applicable.

System and Subsystem Specifications are technical documents prepared for the developer's in-house use. They reflect an intermediate level of system requirements. The documents include detailed information concerning the environment and design elements to provide maximum guidance to the program design effort.

A Program Specification is a technical document which describes program design to permit program production.

A Data Base Specification provides the basic design data necessary for the construction of system files, tables, and dictionaries as well as a description of storage allocation and data base organization.

Three manuals document the completed system, the Command Manual, Operations Manual, and Program Maintenance Manual.

The Command Manual gives the user an overall appreciation of system functions and capabilities and tells him how to use the system.

The Operations Manual provides detailed information concerning control requirements and operating procedures necessary to initiate, run, and terminate the system operations.

The Program Maintenance Manual provides all detailed technical information necessary for maintenance programmer personnel to maintain the system effectively.

The Acceptance Test and Turnover Plan is a tool to direct implementation of a test. It communicates to the user the orderly schedule

of events and list of materials necessary to effect delivery of a completed system and to conduct the orientation required for user operations.

After completion of test, the developer prepares an Acceptance Test Analysis Report to establish a basis for allocating responsibility for deficiency correction.

FLEXIBILITY AND MAINTENANCE

The diversity of programming projects at NAVCOSSACT necessitates a flexible documentation system. Therefore a number of the documents discussed above are optional and are produced at the discretion of the personnel responsible for the project, subject to management review. Paragraphs outlined within each document specification may be omitted by the Project Leader if the paragraphs are not applicable to the project in question.

The system is intended to be dynamic and revisions to the basic document, NAVCOSSACT Instruction 5230.9, Programming Documentation Standards and Specifications, will be published on a 3-6 month basis.

Chemical Information System

Institute For Cooperative Research
University of Pennsylvania
Philadelphia, Pennsylvania 19104

PROJECT CIDS

The Institute for Cooperative Research of the University of Pennsylvania has been engaged in an exploratory project for development of a chemical information and data system under contract to the U.S. Army Edgewood Arsenal. This is part of the Army program known by the acronym CIDS.

This development is viewed as a completely automated, centralized file with a limited selection of information assigned to each chemical compound record which may reference other existing files.

Drs. D. Lefkovitz and C. T. Van Meter prepared a paper which was presented at the American Chemical Society meeting in March 1966 describing the experimental IS&R system currently in pilot test which operates in either real time or batched mode. The system is capable of responding in real time because it employs a random access disk file for storage of the compound records, and a file organization within the disk file obtained by the programming technique called list structuring. Furthermore, the experimental chemical information system, with a list structured file, may also be used in a batched search mode instead of in real time with greater efficiency than is available in present batched search systems.

Computer-Assisted Instruction

Philadelphia Public Schools
Philadelphia, Pennsylvania

The School District of Philadelphia in September took its first steps in computer-assisted instruction at seven schools as one of the principal programs of educational change in the classrooms of tomorrow.

Computer-assisted instruction is a system whereby a computer, working with a pupil's answers to questions in a given subject field, provides instructional sequences geared specifically to the needs and achievement level of the individual pupil.

Experimentation with this system meets one of the principal goals foreseen November 1965 in the report of the special citizens' Task Forces to the Board of Education.

The pilot project was undertaken in conjunction with the IBM Corporation, which provided IBM 1050 typewriter-like terminals in seven schools. They are being serviced by remote IBM 1401 computers located centrally within the school district.

The seven schools, using the keyboard terminals, also will continue another experimental program at two schools involving the use of the 1050 to solve classroom problems in science and mathematics.

The seven schools involved are:

- Roosevelt Junior High, Washington Lane and Musgrave Street.
- Wagner Junior High, 18th Street and Chelten Avenue.
- Central High School, Ogontz and Olney Avenues.
- Germantown High School, Germantown Avenue and High Street.
- Northeast High School, Algon and Cottman Avenues.
- Olney High School, Front Street and Duncannon Avenue.
- Overbrook High School, 59th Street and Lancaster Avenue.

Wagner and Roosevelt began experimentation in spring 1966 with use of the 1050 in solving student problems in science and math. These terminals are connected by regular telephone lines to an IBM computer in New York.

The success of the experimentation prompted an expansion of the program to the five additional schools and also the stepup to computer-assisted instruction pilot programs.

In announcing the expansion and stepup, Dr. C. Taylor Whittier, Superintendent of Schools, said:

"We feel that Philadelphia has become one of the first cities in the Nation to utilize the power of the computer as a basic part of junior high school curriculum.

"We took this step because of the great potential for enriching the teaching of science and mathematics at an early point in the student's career.

"Now, we can clearly see the outline of the school of tomorrow. It will be a school in which the teacher uses the computer as the most sophisticated teaching tool of all, a tool which permits teaching excellence to be the common experience of all students and one which permits each student to progress at his own rate.

"Teachers will be more creative and find themselves able to give each student more individual attention because the computer will have lifted many of the traditional teaching burdens from their shoulders."

Teachers taking part in the 1050 programs were specially prepared for their work at a one-month summer workshop during August, with the Federal Government providing $15,800 of the $22,700 cost.

The teachers obtained instruction in the use of the computers and the various aspects of computer-assisted instruction. They also wrote experimental course materials fed to the computers in September.

Educational computer programs for the Philadelphia Public Schools are under the direction of Mrs. Sylvia Charp, Assistant Director for Data Processing.

Data Message Composer

Rixon Electronics, Inc.
Silver Spring, Maryland 20904

DESCRIPTION

The Rixon Data Message Composer (Figure 1) is a compact, low cost, easily operated input device for direct communication between a remote station and a central computer. The composer is connected to the computer by a standard teletypewriter communication link and employs the conventional 100 word per minute line speed for message interchange. It can be configured to include an answer-back capability to provide real time information retrieval. Or it can be used simply as a sending set to input information into a computer.

APPLICATIONS

The flexibility of the Composer permits its use in a wide variety of applications. Reservation systems, inventory, production and document control, accounting and order entry, for example, could all be automated with installations of Data Message Composers.

OPERATION

Data is entered through an almost foolproof vertical dialing system (Figure 2). Behind each

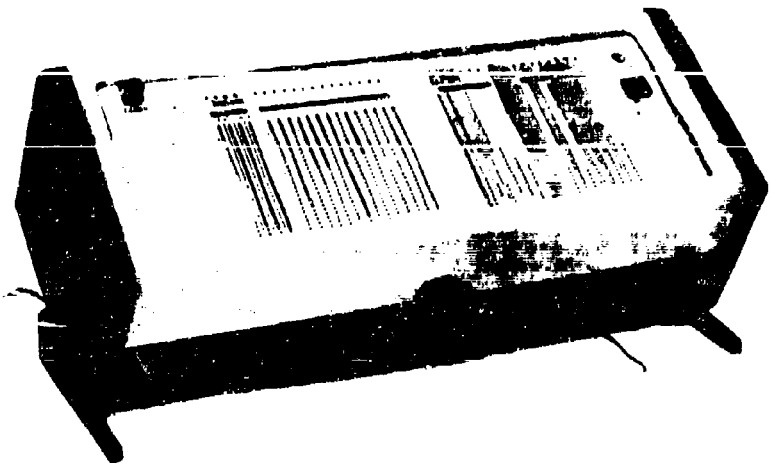

Figure 1

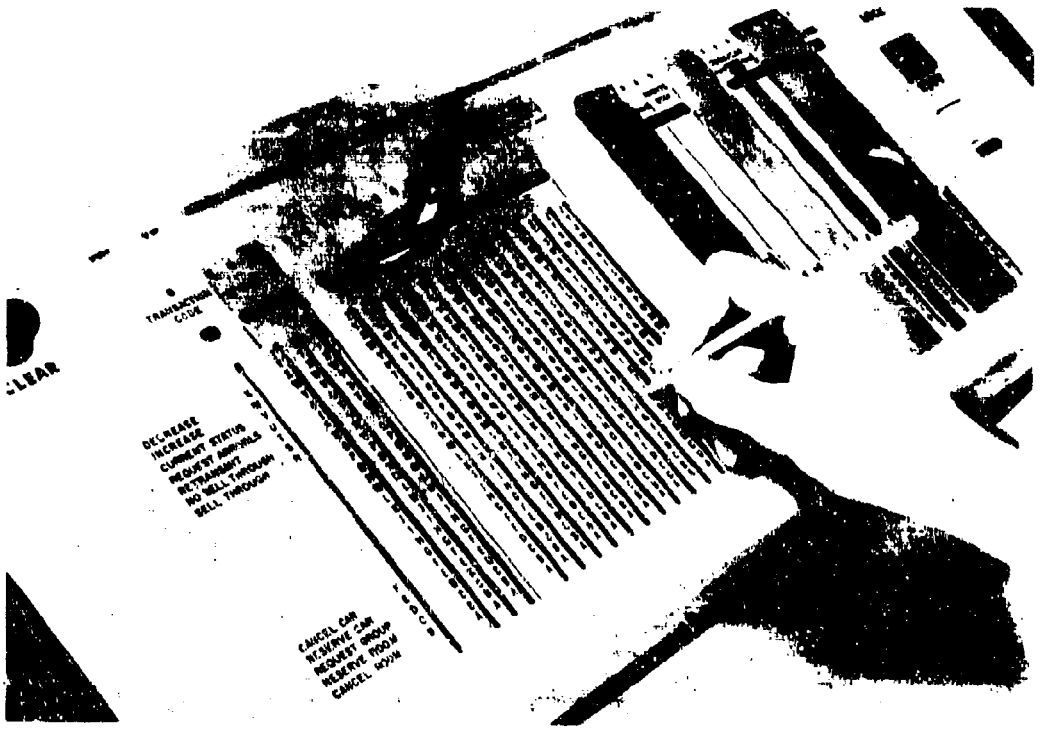

Figure 2

of the vertical slots on the faceplate there is a perforated mylar ribbon. Alpha, numeric, or special symbols are printed along one edge of the slot. To input information, insert a stylus adjacent to the desired character and pull the ribbon downward to the bottom of the slot. This action stores one character of the message. The process is continued until the message is complete.

Each of the selected characters appears in the horizontal window above the vertical slots. This readout lets the operator proof and quickly detect any errors before transmission. They are easily corrected by clearing the individual column and re-entering the desired character.

No typing or other special skills are required to operate the Composer accurately and efficiently. With the vertical dialing system a person can use the Composer after very little instruction. The ease of operation and minimal training required are important when you frequently add new people to your staff.

The fixed format faceplate permits data to be entered in any sequence. Unlike a keyboard input device, there is no need to wait for all information before entering any portion of the message. An operator can receive data over the phone, for instance, and enter it just as it is given. Proper formatting of the message is automatically accomplished through the Computer faceplate design.

Messages are transmitted by simply pressing the send button. If the communications circuit is busy, which may happen where there are several Composers on the same line, the busy signal will light. But, as soon as the line is clear, the Composer is automatically energized and the message transmitted.

The data are locked into the Composer until a clear button is pressed. If the message must be retransmitted, the data do not have to be entered again. Just push the send button again for a repeat transmission.

The Composer is linked to the computer with a low-cost teletypewriter circuit. The output signal is a 5-element, 7.5 unit, serial code which can be inserted directly into a teletypewriter circuit. Code converters can be supplied for specific application requirements.

The Composer is built to meet the customer's specific application. It can contain up to 45 data entry columns with 26 Alpha, numeric or special symbols per column. The customer chooses the format. Optional features such as line printer, paper tape punch adapter, code converter, and acoustic coupler link further increase the Composer's flexibility.

Vertical dialing data entry; no special skills such as typing required for operation; complexities of keyboards eliminated.

All data inputs automatically pre-formatted; information may be entered in any sequence.

Messages can be easily proofread before transmission.

Uses low cost teletypewriter communications links.

Composers tailored to specific requirements; use up to 45 entry columns with 26 alpha, numeric, or special symbols per column.

Optional features available include line printer, paper tape punch adapter, code converter, and acoustic coupler link.

Mechanical

Size	23" long x 9-1/4" wide x 6-1/2" high
Weight	Less than 30 lb

Electrical

Power Requirement	110-120 volt ac
Power Consumption Standby Condition .	15 watts
During Message Transmission . .	45 watts
Output Signal	5 element, 7.5 unit serial code
Line Speed	10 characters per second, 100 words per minute
Environmental Tolerance	Proper operation is assured over a temperature range of 50° to 110° F and a humidity range of 20 to 95%

Optical Page Reading

Social Security Administration
Baltimore, Maryland

During July 1966, the Social Security Headquarters, in Baltimore, Maryland, placed into operation the most advanced optical scanning system in operation anywhere in the world—it is known as the IBM 1975 Optical Page Reader. The IBM 1975 was designed and built by IBM Corporation especially for the Social Security Administration. Mr. Robert M. Ball, Commissioner of Social Security, announced in August that the system had met all operational requirements during a vigorous 30-day acceptance test.

The Optical Page Reader is a sophisticated character recognition device capable of reading more than 200 different type faces at speeds of more than 650 lines of information per minute. Under control of an IBM System/360 Model 30, the 1975 reads the names, Social Security numbers, and quarterly earnings of about half of the 70 million wage-earners in the United States. These quarterly reports are submitted by 3.5 million employers. As a form is read, the computer transfers the automatically scanned data onto magnetic tape for later processing. In this manner, about a quarter of a million lines of data, contained on a stack of forms 4-feet high, can be read and recorded on tape in slightly more than 8 hours. By comparison, manual keying of this data into punched cards would take a key punch operator more than 100 days. Mr. Ball estimates that the new system should result in an annual saving of more than $750,000.

Formerly, the information from employers' wage reports had been read and punched onto cards by key punch operators. The punched cards were then run through a "card-to-tape" machine which translated the information into computer language and transcribed it electronically onto magnetic tape.

The Optical Page Reader eliminates the need for key punching information on those employer reports prepared by business machines, computer printers, or standard typewriters. Through a highly advanced character recognition system, the scanner can read more than 200 typewriter or tabulator fonts, in upper and lower case format, including both alphabetic and numeric information. It will be able to process about half of the 70 million entries on individual social security records made in the Social Security Administration each calendar quarter of the year.

The manual card punch system will continue to be used to transcribe handwritten reports, non-standard typewritten reports, and sections of other reports that are set aside by the Optical Page Reader because of strikeovers or other flaws.

The installation of the new optical scanning equipment is another step in the application of electronics to Social Security recordkeeping, begun 15 years ago, Ball said. An early computer was put to work in 1950, he recalled, making trial benefit computations.

In 1956, the Social Security Administration installed its first large scale computer to maintain records of earnings for the Nation's working people and also to compute the benefits payable to workers and their families when they retire, become disabled, or die.

The data processing system is being integrated to link the earnings-record operations with the benefit-paying operations, covering the entire range from the issuance of a social security account number to a new worker, through the maintenance of his lifetime earnings record, to the adjudication of his claim for benefits and any subsequent change in status as a Social Security beneficiary.

With the new medicare program in operation, Ball said, the hospital insurance and voluntary medical insurance eligibility records of medicare beneficiaries are also being kept up to date by the Social Security Administration's data processing system.

The use of electronic data processing in the Social Security Administration's massive recordkeeping task has insured accuracy and saved millions of dollars in social security tax contributions, the Social Security Commissioner stated.

"These savings," he said, "have enabled the Social Security Administration to continue to provide direct, personal service to the public at social security district offices around the country and to conserve social security and health insurance trust fund money for the payment of social security benefits."

The IBM 1975 Optical Page Reader will do the work of 120 to 140 key punch operators after it has been completely phased into operations, the Social Security Commissioner noted. It will also result in speedier processing of one of the

Social Security Administration's larger workload items. The agency currently posts over 260 million entries of earnings per year to the individual social security accounts of the Nation's working people.

No one will lose his job because of this development, Commissioner Ball announced. He said that the 120 to 140 key punch operators freed by the new optical scanner will be reassigned to other necessary tasks in the Social Security Administration's recordkeeping operations. They will also be needed to handle the increased workload resulting from the new medicare program and the significant changes in the existing Social Security Program enacted in the Social Security Amendments of 1965.

The Social Security Administration is leasing the new equipment with an option to purchase. It is estimated that the amount of savings it will produce in the first full year of operation will approximate the purchase price of the equipment.

SYSTEM CHARACTERISTICS

Developed at IBM's Systems Development Division laboratory in Rochester, Minn., the 1975 consists of two key elements: (1) a high-resolution cathode ray tube scanner, which performs the character recognition, and (2) a high-speed paper transporting mechanism which feeds the printed documents to the scanning device.

The scanner in turn has two elements: (1) a reading mechanism which detects the presence of characters on the printed page, and (2) a character recognition section which identifies the images. The entire recognition process for a character takes less than 800-millionths of a second.

Optical Scanning

The scanning, or reading, portion of the Optical Page Reader consists of a cathode ray tube, a high resolution optical system, and photomultiplier detectors.

A moving light spot that originates on the face of the cathode ray tube is focused on each document through an optical system. As the spot sweeps across a character, the presence or absence of ink on paper is detected by the photomultipliers and relayed to the character recognition section of the machine.

In addition to scanning characters, the scanner locates the line of print, centers the scan on the line, and normalizes, or adjusts, the scan height. Normalization is required to accommodate the wide variety of type sizes on Social Security forms. The centering function of the scanner automatically traces the line and adjusts itself periodically so that skewed lines of print may be scanned without loss of data.

New techniques in video processing such as contrast control, dynamic video threshholding, and data reduction circuits have been added to minimize the usual difficulty in recognizing seriously degraded forms and printing.

Character Recognition

The video image, generated by the scanner when it detects a character on paper, enters a storage register in the character recognition section, where it is subjected to logical tests for several hundred different conditions. This is done statistically by measuring and examining the bit pattern generated by the scanner.

When identification of a character cannot be made with statistical confidence, the machine initiates alternative steps, including searching through alternate memory sections and altering the decision-making parameters. This approach to character recognition is relatively independent of details in printing styles and thus resolves many minor differences between the same character printed in different type fonts.

Document Handling

Pages to be read are stacked on a hopper elevator beneath the console of the Optical Page Reader. The documents are transported one sheet at a time for reading at speeds of 100 inches per second. They may vary in size up to 8-1/2 X 11 inches. The transport is designed to accommodate reports that vary in thickness and those that are mutilated by folding or crumpling.

A feature of the system is its ability to mark lines containing rejected characters. The recognition system identifies the rejected character, the scanner locates the position of the line of print on the document, and the printing mechanism marks the designated line while the document is in flight to the stackers. After scanning, reports are deposited in stackers located on the side of the 1975 directly beneath the entry point.

Computer Assisted Education

U.S. Naval Academy
Annapolis, Maryland 21402

Initial steps were taken in July 1966 to bring present-day computer technology directly into the academic programs at the U.S. Naval Academy as 15 faculty members began a summer study of computer-assisted education.

The project, sponsored by the Office of Naval Research and strongly supported by the Bureau of Naval Personnel and major naval computation centers in the Washington area, was to establish guide lines and techniques for use of computers in classroom applications in the various academic departments.

The study required that participating instructors become skilled in the application of information systems to classroom education. Currently, the rapid expansion of research in essentially all areas of science and management has also compelled the use of the computer in virtually a "sink or swim" category.

Naval officer education now is adjusted to life in an increasingly complex technological world where it is necessary to understand and use information systems with competence. In addition, these systems are applicable to the learning process itself. The summer study project was unique in the Services in its direct exploration of computer-assisted education by a group of educators. The program was headed by Paul L. Quinn, director of the Academic Computing Center, U.S. Naval Academy. Mr. Quinn, who is also the Naval Academy's crew coach, looked for three major benefits: (1) expanded horizons for participating faculty members; (2) greater exploratory potential for the midshipman student; and (3) increased individualized learning since materials may be readily adapted to meet specific student needs.